

**National Climatic Data Center**

**DATA DOCUMENTATION**

**FOR**

**DATA SET 3271 (DSI-3271)**

***IN SITU* Carbon Dioxide Discrete Flask Sample Measurements – Mixing Ratio**

**February 21, 2003**

National Climatic Data Center  
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1. **Abstract:** This data set represents the most comprehensive carbon dioxide flask data set available in the world. The data set contains carbon dioxide mixing ratio in parts per million (ppm) based on measurements from the NOAA/CMDL Cooperative Flask Sampling Network from 1967-1991. There are 34 worldwide sites of which 32 were still active in 1991. These data are updated periodically as part of a cooperative effort between CMDL and NCDC which is supported as a core project by NOAA's Climate and Global Change Program. These data are also available on-line via internet on a CMDL workstation.

Surface flask samples were made to ensure that the collected sample was not contaminated from local sources of carbon dioxide. The observer was instructed to take an air sample only when the wind was in excess of 2 meters per second blowing from the clean air sector near the site. All flask samples were shipped from the station to the NOAA/CMDL laboratory located in Boulder, CO and analyzed for carbon dioxide.

The air samples were collected by two general methods: by flushing and then pressurizing the glass flasks with a pump or by opening a stopcock on an evacuated glass flask. Normally, the collection involved the connecting of two flasks in series.

The time between sample collection and analysis usually ranged from several days to about 1 month. However, for some remote sites such as Amsterdam Island and all Antarctica sites, the time period between collection analysis averages 6 months. Some flask samples from these remote sites were stored for more than one year.

Extensive quality checks are performed at the CMDL laboratory on all flask samples. Samples are occasionally found to be contaminated by local sources of carbon dioxide which do not represent the background concentration. In other cases, flask samples were found not to be adequately pressurized or not adequately flushed before pressurization.

Since samples are collected in pairs, the pair difference is calculated, and samples with a pair difference greater than 0.5 ppm are flagged. Through 1988, one member of a bad pair was sometimes retained if it fell within +/- 3 sigma from a fitted curve. From 1989 to the present, both members of bad pairs have been automatically rejected. All original observations have been retained in this data set but have been designated with various quality flags if problems were found.

2. **Element Names and Definitions:** STATION-ID - This is a 3-character alphanumeric representing a station identifier assigned by CDML. Allowable values are listed under topic STATION: Network participation, along with station name and other identifier information.

Collection Date - This is a 6-character integer representing the Greenwich Mean Time (GMT) date (year, month, day) that the flask sample was collected at the cooperative station. Allowable values range from 680101 to current.

Collection Hour - This is a 2-character integer representing the GMT hour that the sample was collected at the cooperative station. Allowable values are 00 to 23 and 99, where 99 represents a missing

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value.

Collection Minute - This is a 2-character alphanumeric integer representing the GMT minute that the sample was collected at the cooperative station. Allowable values are 00 to 59 and 99, where 99 represents a missing value.

Flask ID - This is an 8 character alphanumeric representing the flask-id assigned to each flask. The code may be used to aid in combining the carbon dioxide measurement data with methane data obtained from the same flask. The Flask ID, Collection Data and Time uniquely identify each flask observation.

Collection Method - This is a 1-character alphanumeric representing the method that was used in collecting the flask sample. Allowable values are:

P - Portable, battery-powered suitcase sampler. Two flasks normally connected in series, flushed with air, then pressurized to 1.25-1.5 ambient atmospheric pressure.

T - Filling of an evacuated 3-liter glass flask by opening the single O-ring sealed stopcock.

S - Filling of 0.5 liter glass flasks (in pairs) at the NOAA/CMDL observatory sites. Flasks are filled and pressurized by diverting air from continuous in-situ CO<sub>2</sub> analysis systems.

N - Before 1981, flasks filled using a hand-held aspirator bulb. After 1981, filling and pressurizing of 0.5 liter glass flasks (in pairs) by a pump different from that supplied by NOAA/CMDL (used with collection method P). In most cases (eg. at NWR and CGO) the pump is a Metal Bellows pump. In addition, the flasks filled by this method at the Cape Grim Baseline Air Pollution Station (site code CGO) are filled with air that has been dried chemically.

F - Filing of an evacuated 5-liter glass flask by opening the single ground-glass greased stopcock.

CO<sub>2</sub> concentration - This is a 6 character real number representing the carbon dioxide mixing ratio in parts per million (ppm). An example of a value for this field is 328.44 ppm. Missing values are denoted by 999.99.

Instrument Type - This is a 2 character alphanumeric identifying the instrument used for the CO<sub>2</sub> flask measurement. Valid codes are S1, U1, U2, U3, L1, and L2.

Analysis Date - This is a 6 character integer representing the (local Boulder CO time) date (year, month, day) that the flask sample was analyzed at CMDL. Allowable values range from 680101 to current.

Quality Flag 1 and 2 - These are 1-character alphanumeric fields representing the corresponding quality flag assigned to each carbon dioxide mixing ratio. One must utilize both quality flags 1 and 2 to

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determine whether or not the CO<sub>2</sub> mixing ratio has been accepted or rejected. Since samples are collected in pairs, the pair difference is calculated, and samples with a pair difference greater than 0.5 ppm are flagged. Through 1988, one member of a bad pair was sometimes retained if it fell within  $\pm 3$  sigma from a fitted curve. From 1989 to the present, both members of a bad pair have been automatically rejected. A simple rule to follow in determining rejected and accepted values: if the first of these two characters is blank, then the CO<sub>2</sub> flask sample is accepted; if the first character is not blank, then the flask sample is rejected. Retained and rejected flasks are flagged as follows, where blanks are denoted by the letter 'b':

	Flag 1 & 2	Description
Retained	bb	good pair (simple difference $\leq 0.5$ ppm)
	bH	high member of a bad pair; retained
	bL	Low member of a bad pair; retained
	bS	single flask; retained
Rejected	+b	high member of a bad pair; rejected
	-b	low member of a bad pair; rejected
	Xb	rejected as not a representative of background ( $>3$ sigma from a fitted curve)
	Rd	single flask; rejected
	*b	off scale or broken flask; rejected
	Nb	error in sampling or analysis; rejected

3. **Start Date:** Data goes back to 1968. Dates vary by station.
4. **Stop Date:** Currently 1991. This data set is periodically updated with most recently observed flask samples.
5. **Coverage:** Latitude range: 82 degrees north to 90 degrees south.  
Longitude range: 180 degrees east to 180 degrees west.
6. **How to Order Data:** Ask NCDC's Climate Services about the cost of obtaining this data set.

Phone: 828-271-4800  
 FAX: 828-271-4876  
 e-mail: [NCDC.Orders@noaa.gov](mailto:NCDC.Orders@noaa.gov)

7. **Archiving Data Center:**

National Climatic Data Center  
 Federal Building  
 151 Patton Avenue  
 Asheville, NC 28801-5001  
 Phone: (828) 271-4800

8. **Technical Contact:**

Climate Monitoring and Diagnostics Lab  
 NOAA/ERL

:

R/E/CG1  
325 Broadway  
Boulder, CO 80303

National Climatic Data Center  
Federal Building  
151 Patton Avenue  
Asheville, NC 28801-5001  
Phone: (828) 271-4800

9. **Known Uncorrected Problems:** None.

10. **Quality Statement:** On a scale of 0 to 2, the quality level of this data set is 2. The data set has gone through extensive quality control. Quality checks have been performed by CMDL on the actual data carbon dioxide flask concentrations. NCDC has performed internal consistency checks on the historical file for all data fields. The resulting flask samples represent the most comprehensive CO<sub>2</sub> data set for the remote, well mixed global troposphere. The values which have been flagged to be representative, are used to calculate long-term trends and interannual and seasonal variations in studies of the global carbon cycle. It is possibly, and even likely, that some of the values rejected through quality control were valid measurements but represented poorly mixed air masses influenced by local anthropogenic sources or strong local biospheric sources or sinks. Users of these data should be aware that data selection or quality control is a difficult but necessary aspect of the analysis and interpretation of atmospheric trace gas data sets, and that the specific data selection scheme used may be determined by the goals of a particular investigation. As a result, all original values have been retained in this data set but have been flagged as accepted or rejected.

11. **Essential Companion Datasets:** None

12. **References:** The following references are available for more detailed information. The Komhyr et al. (1985) article gives extensive details on the entire carbon dioxide program.

Conway, T.J., P. Tans, L.S. Waterman, K.W. Thoning, K.A. Masarie, and R.H. Gammon, 1988: Atmospheric carbon dioxide measurements in the remote global troposphere, 1981-1984. *Tellus*, 40B, 81-115.

Komhyr, W.D. L.S. Waterman, and W.R. Taylor, 1983: Semiautomatic nondispersive infrared analyzer apparatus for CO<sub>2</sub> air sample analyses. *J. Geophys. Res.*, 88, 1315-1322.

Komhyr, W.D., R.H. Gammon, T.B. Harris, L.S. Waterman, T.J. Conway, W.R. Taylor, and K.W. Thoning, 1985: Global atmospheric CO<sub>2</sub> distribution and variations from 1968-1982 NOAA/GMCC CO<sub>2</sub> flask sample data. *J. Geophys. Res.*, 90, 5567-5596.

Tans, P.P. T.J. Conway, and T. Nakazawa, 1989: Latitudinal distribution of the sources and sinks of atmospheric carbon dioxide from surface observations and atmospheric transport model. *J. Geophys. Res.*, 94, 5151-5172.

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Tans. P.P., I,Y, Fung, and T. Takahashi, 1990: Observational constraints on the global atmospheric CO<sub>2</sub> budget, Science, 247, 1431-1438.

Thoning, K.W. P. Tans, T.J. Conway, and L.S. Waterman, 1987: NOAA/GMCC calibration of CO<sub>2</sub>-in-air reference gases: 1979-1985. NOAA Tech. Memo. (ERL ARL-150). Environmental Research Laboratories, Boulder, CO, 63pp.

[www.cmdl.noaa.gov/](http://www.cmdl.noaa.gov/)

<http://www-cave.larc.nasa.gov/cave/cave2.0/Projects.dir/CMDL.html>

<http://www.cmdl.noaa.gov/hats/insitu/cats/>

Filename: td3271.txt  
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